

Estimated Requirements for Launch Vehicles

NASA plans to develop the Ares I and Ares V launch vehicles to support the existing International Space Station program as well as the Moon/Mars Initiative. Ares I and Ares V will be launched from Launch Complex-39 at the Kennedy Space Center (KSC). Figure 1 shows an Ares I and Ares V to scale to the current space shuttle. Ares I and Ares V will use the Solid Rocket Booster technology from the Space Shuttle Program and also continue to use liquid hydrogen and liquid oxygen rocket engines.

The Air Force's Evolved Expendable Launch Vehicle (EELV) program launches from the Cape Canaveral Air Force Station (CCAFS), which adjoins the KSC. The launch vehicles include the Atlas V and Delta IV from United Launch Alliance. Although separate from the EELV program, Space Exploration Technology also plans to launch from the Cape Canaveral Air Force Station.

Some launch requirements are similar between the vehicles at KSC and CCAFS. Specifically for this study, four commodities are considered: hydrogen, oxygen, nitrogen, and helium. The specific requirements (flow rates and consumption) for Ares I and Ares V are shown in Appendix 1 and Appendix 2. Figure 2 shows the typical propellant (liquid hydrogen and liquid oxygen) loading of the vehicles. The propellant loading process is estimated from current Space Shuttle Program data as described in the "Overview of Current Cryogenic Propellant Operations for Space Shuttle" section.

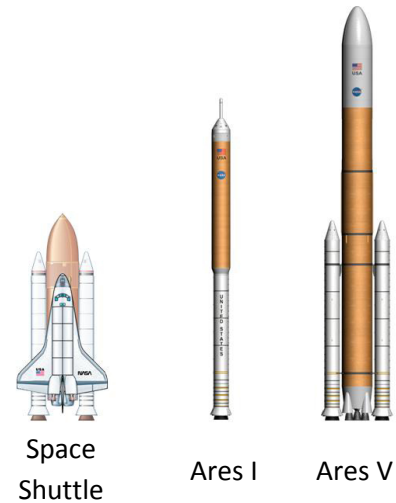


Figure 1: Current and Future NASA Vehicles

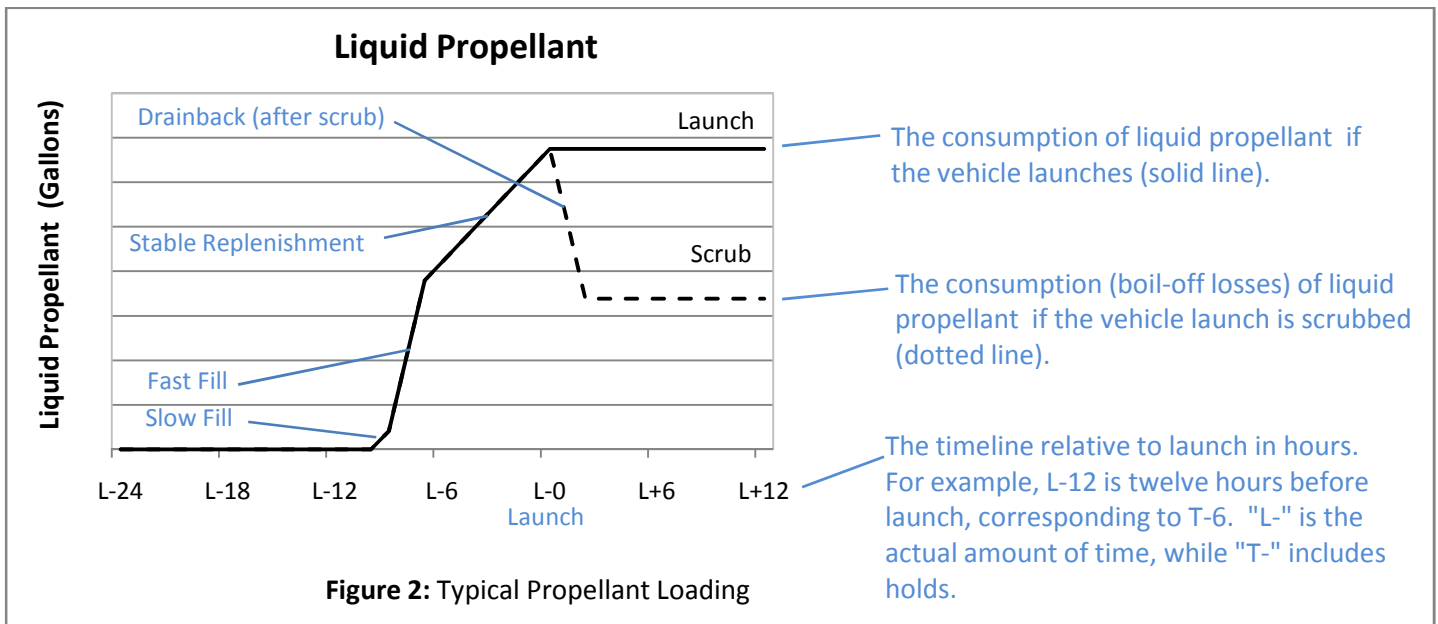
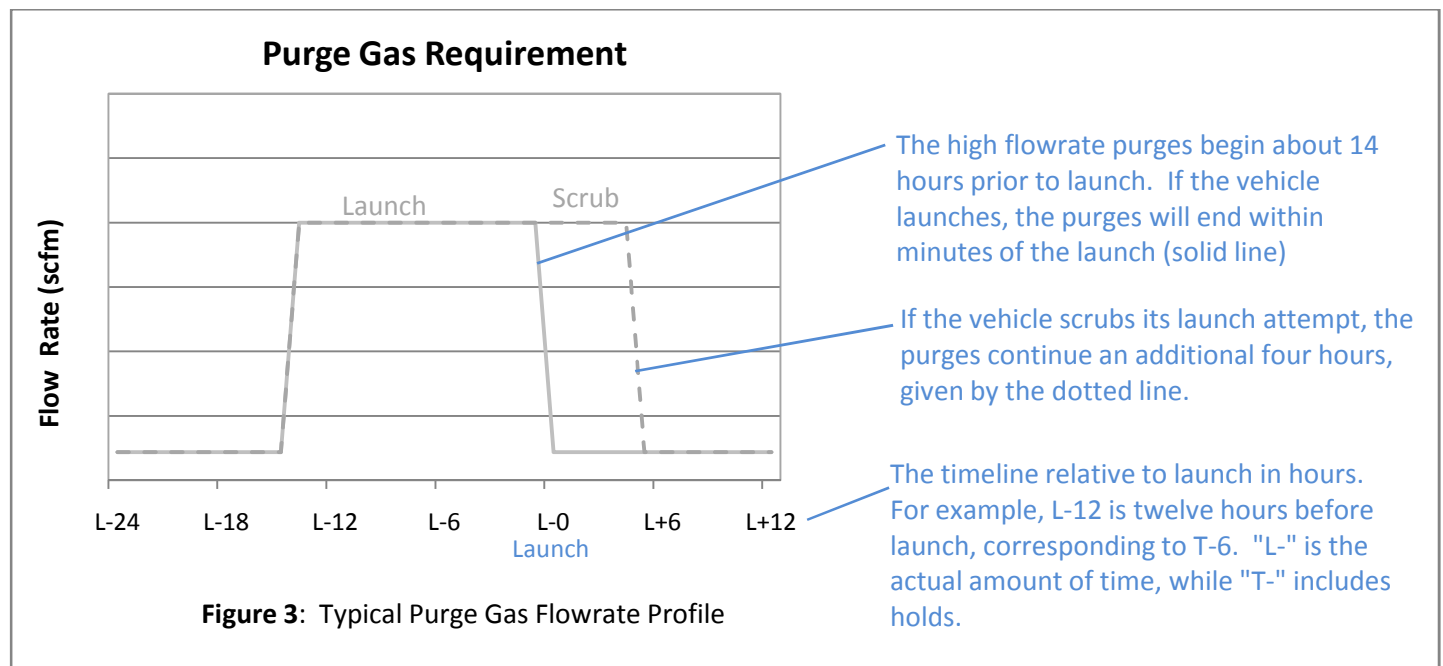


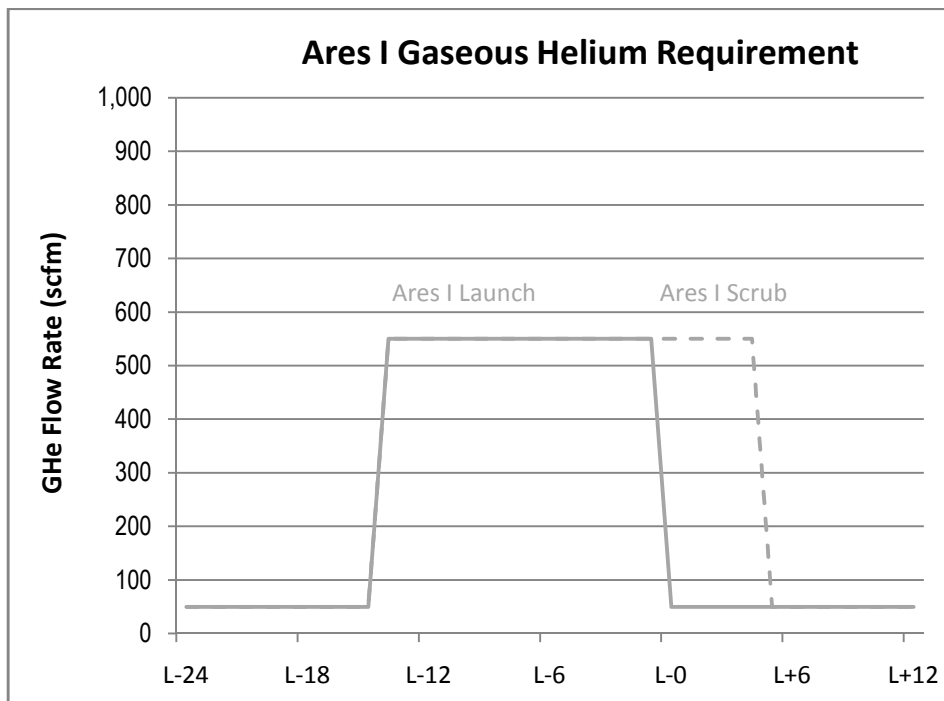
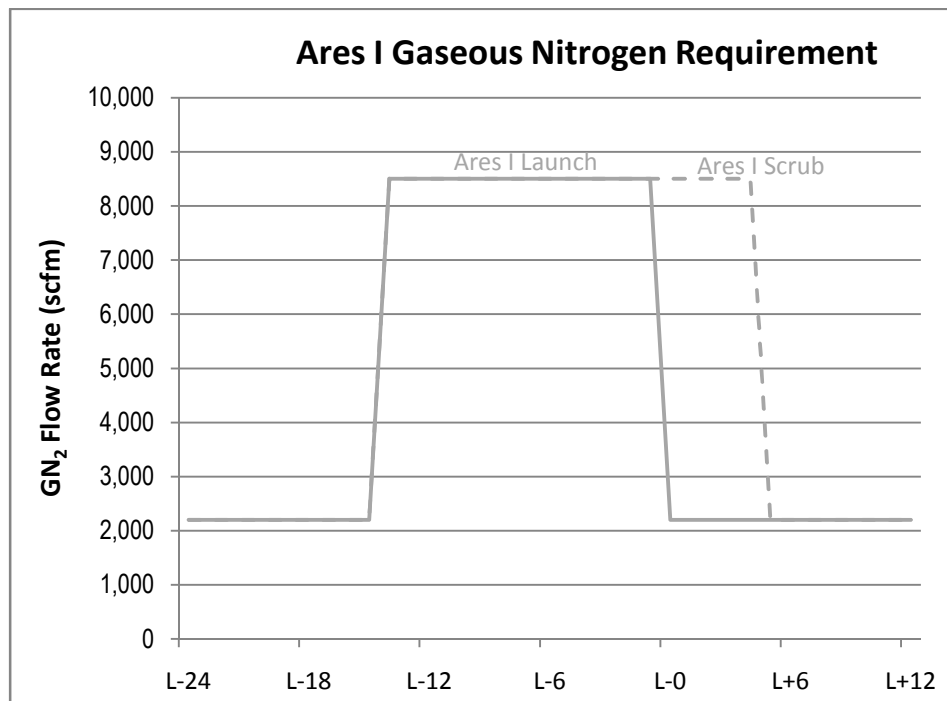
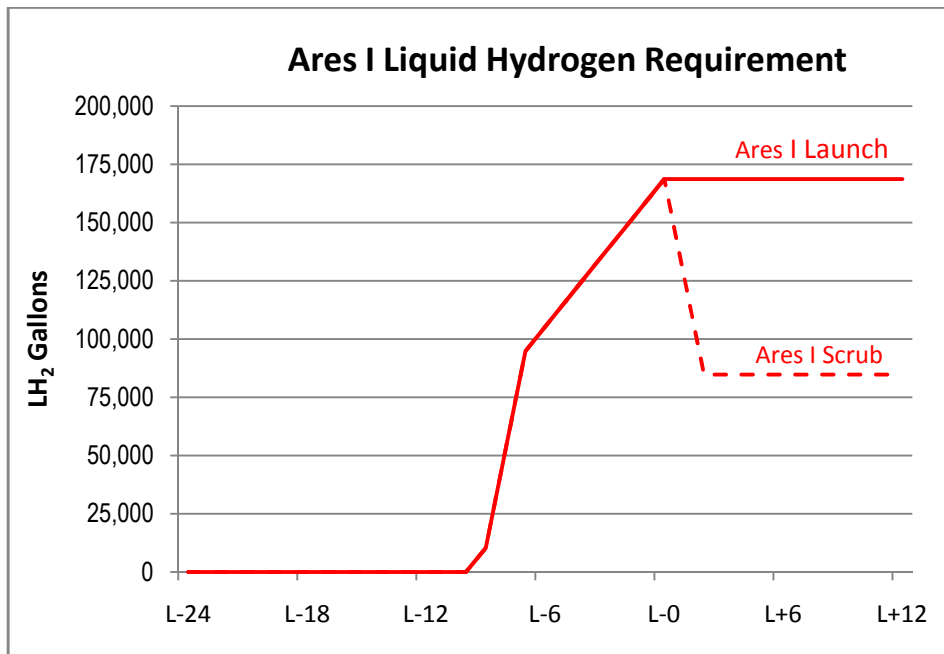
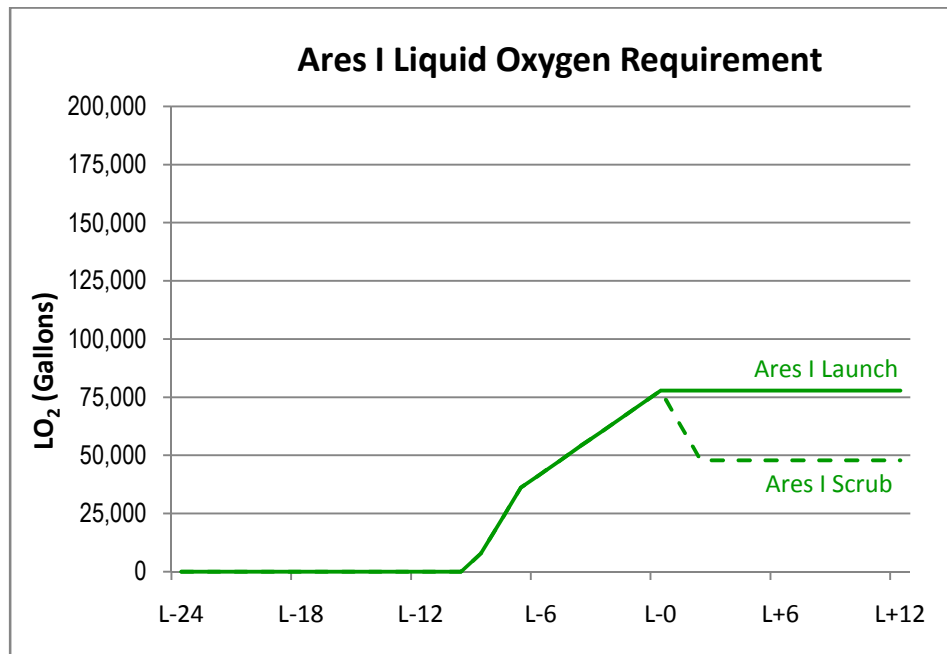
Figure 3 shows the typical purge gas (gaseous nitrogen and gaseous helium) requirement during the launch countdown the vehicles. The purge gases flow rates are estimated from current Space Shuttle Program data is described in the “Overview of Current Purge Gas Operations for Space Shuttle” section.



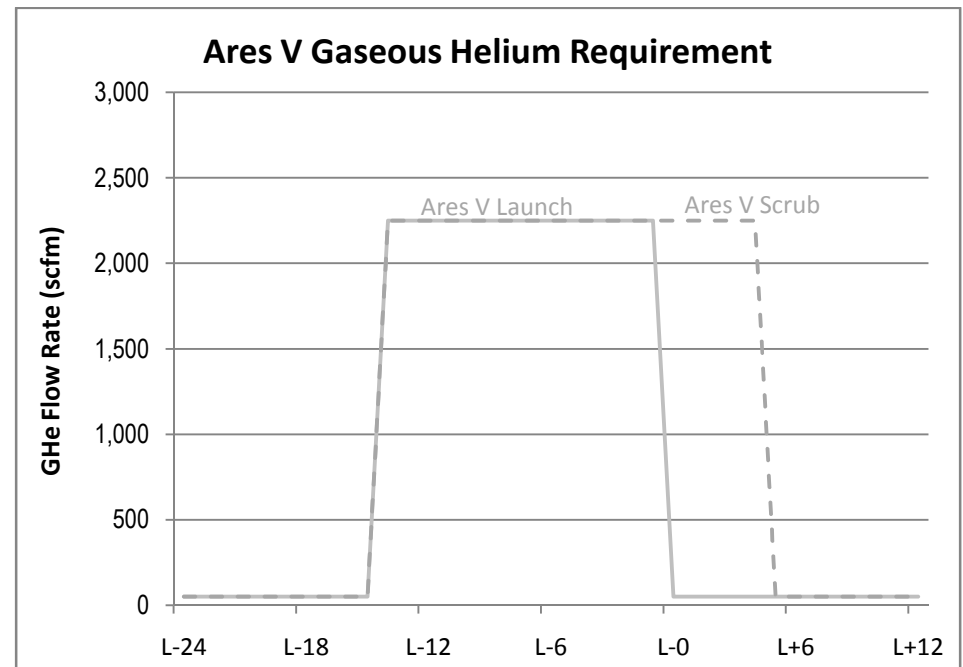
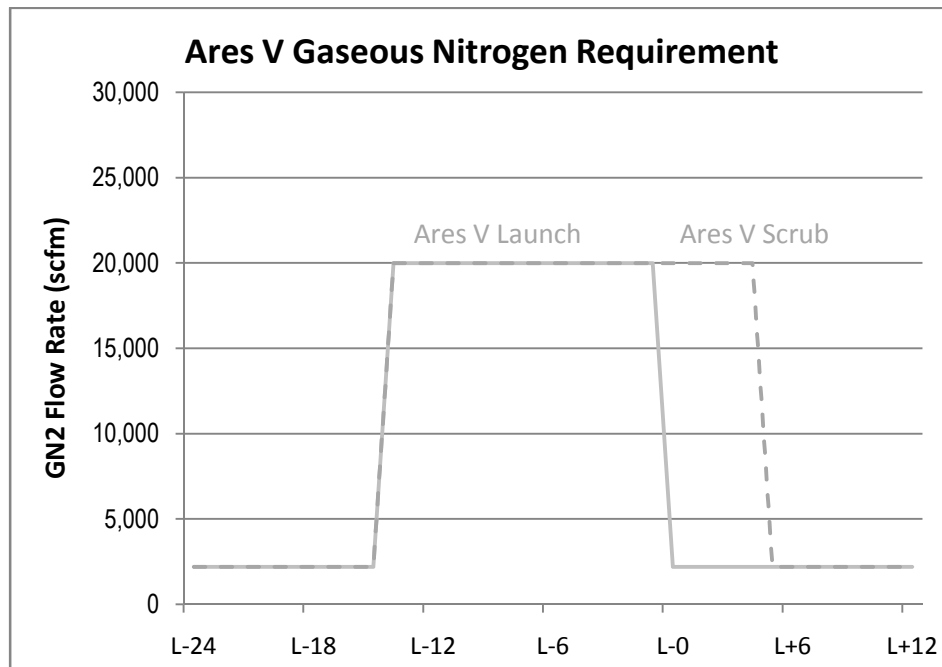
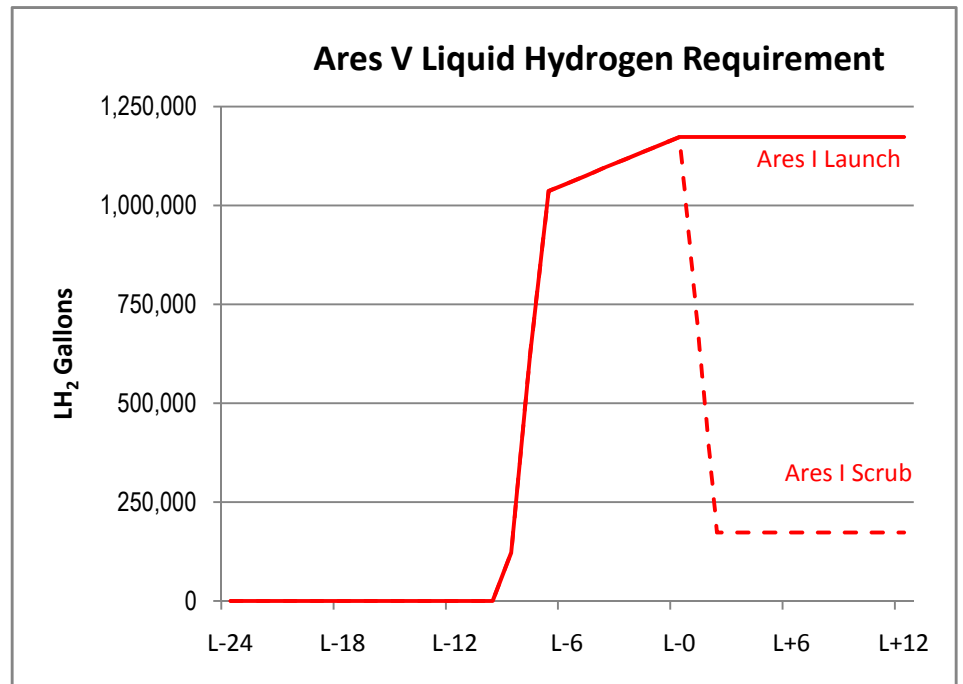
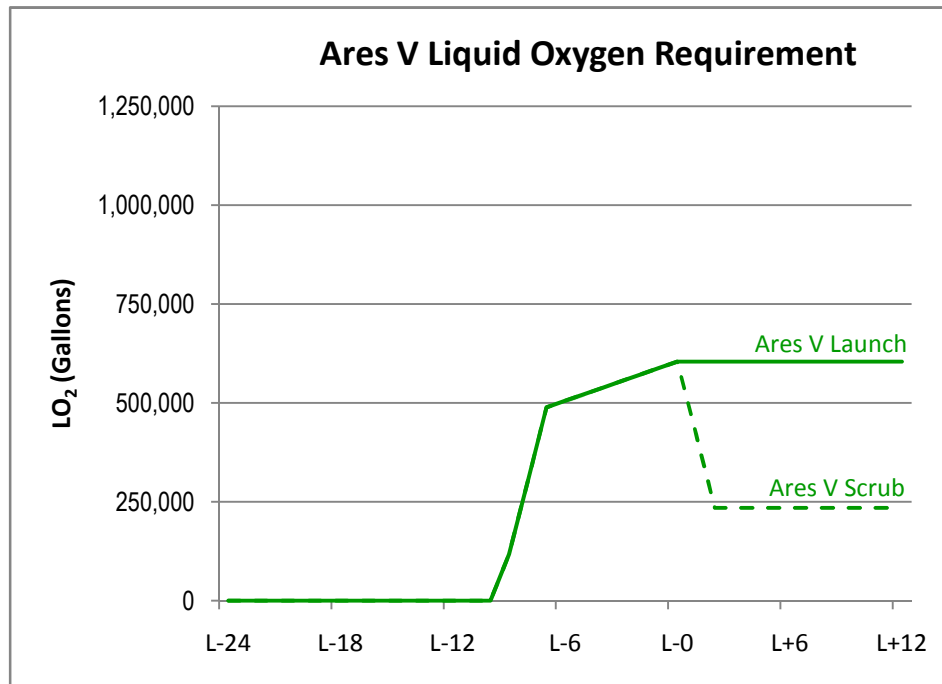
Note that the propellant is shown as the total propellant consumed, while the purge gasses are given as the required flow rate. Also, a scrubbed launch attempt uses less liquid propellants, but more purge gas than a successful launch. Currently, all liquid propellant systems are unique to a vehicle, in other words, each launch pad has its own storage and transfer system. However, the purge gas system is common to all vehicles (i.e. supplied via common pipelines). With the exception of Ares I and Ares V, two vehicles will not require elevated purge gas flow rates at the same time. On the occasions of an Ares I and Ares V launching on the same day, the purge gas flow rates are additive.

For the purposes of this study, a year's worth of requirements have been developed in Appendix 3 – Appendix 6. The graphs show the daily use of liquid propellants (gallons/day) and purge gasses (standard cubic feet/day) and reflect current Constellation Program requirements as well as typical or anticipated EELV requirements. On each graph a baseline level exists and the peaks represent launch attempts, scrubbed launch attempts, or testing. The liquid propellant baseline is the normal evaporation (boil-off) from the storage tanks.

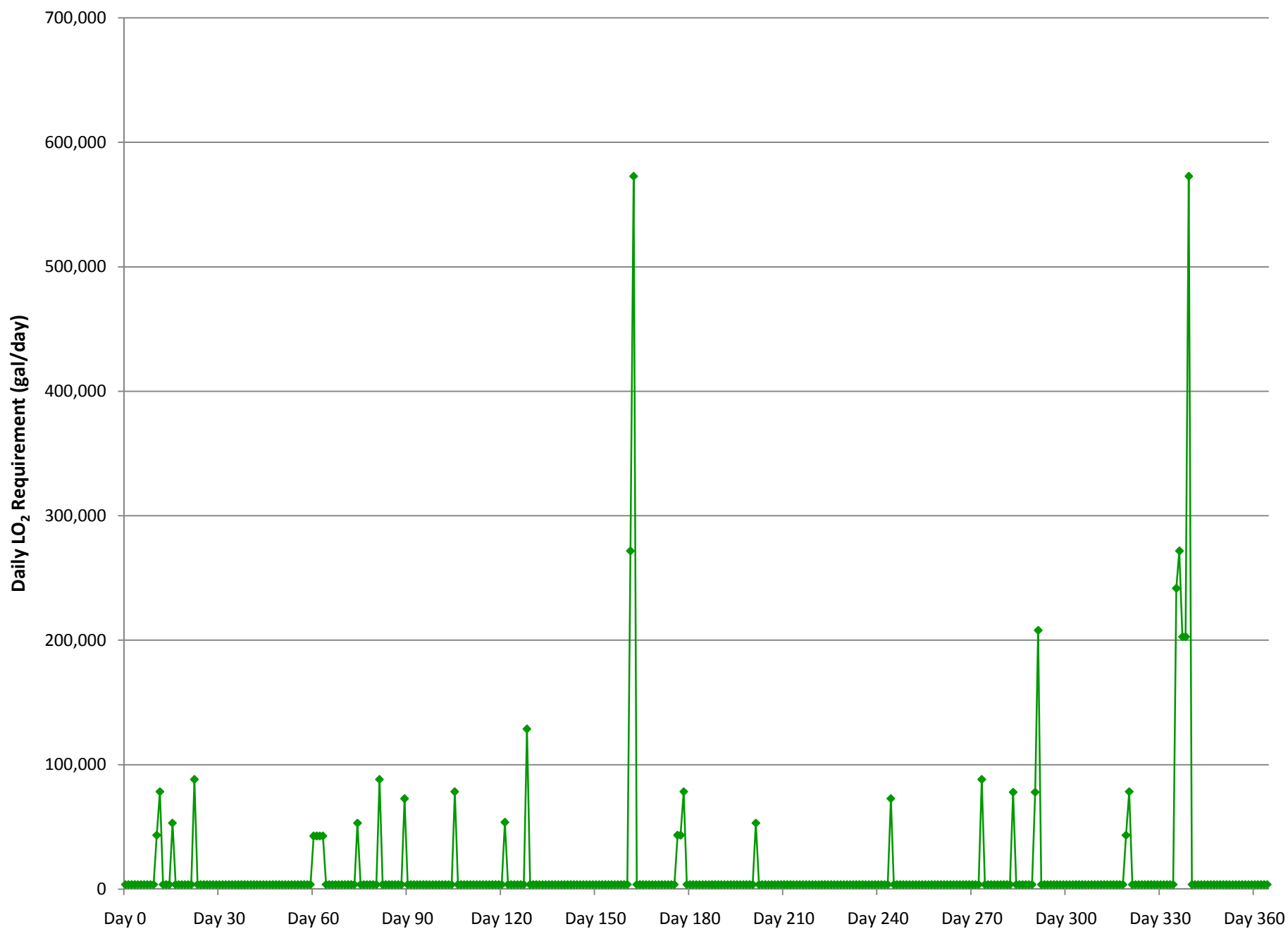
Appendix 1: Ares I Launch and Scrub Requirements



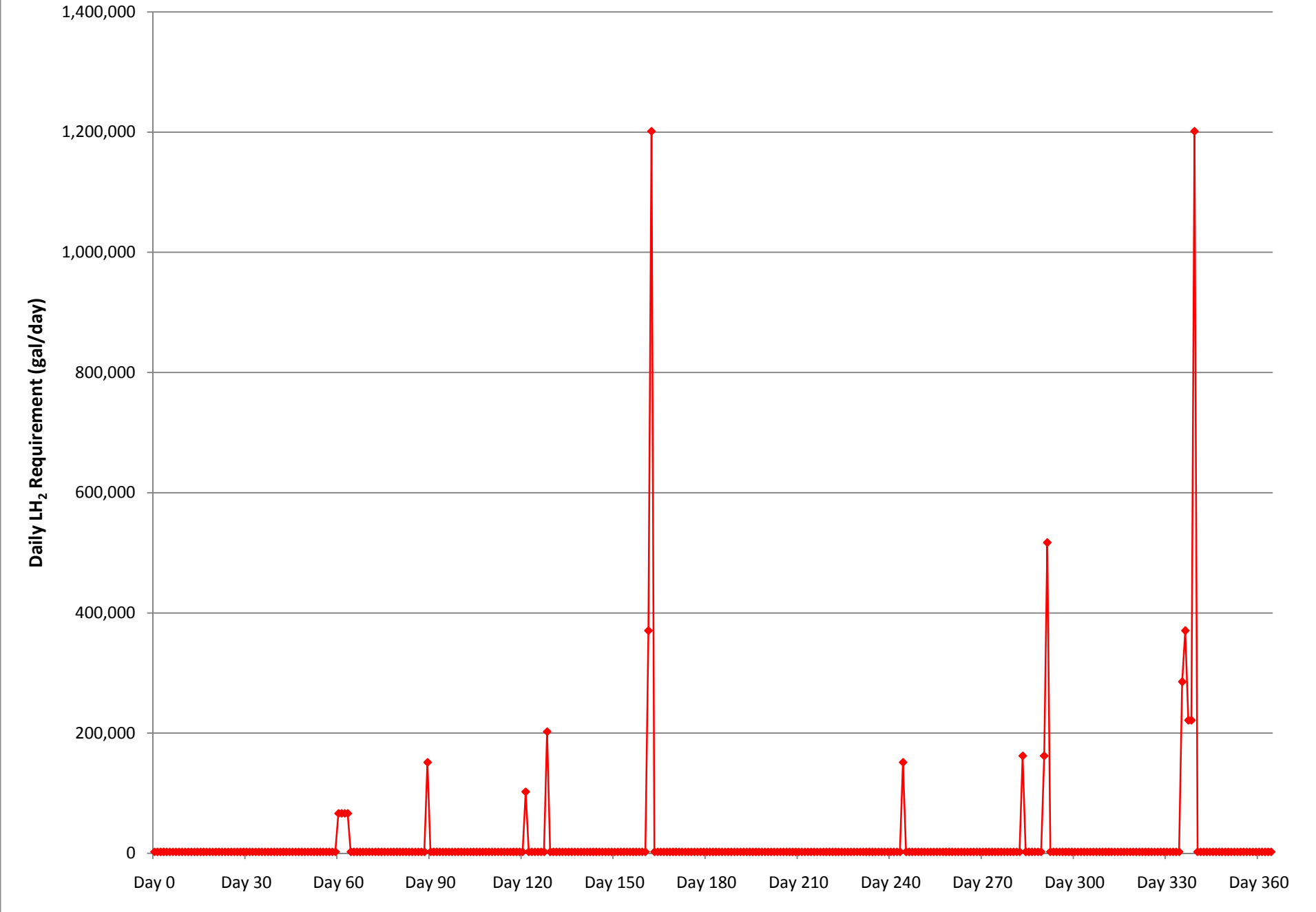
Appendix 2: Ares V Launch and Scrub Requirements



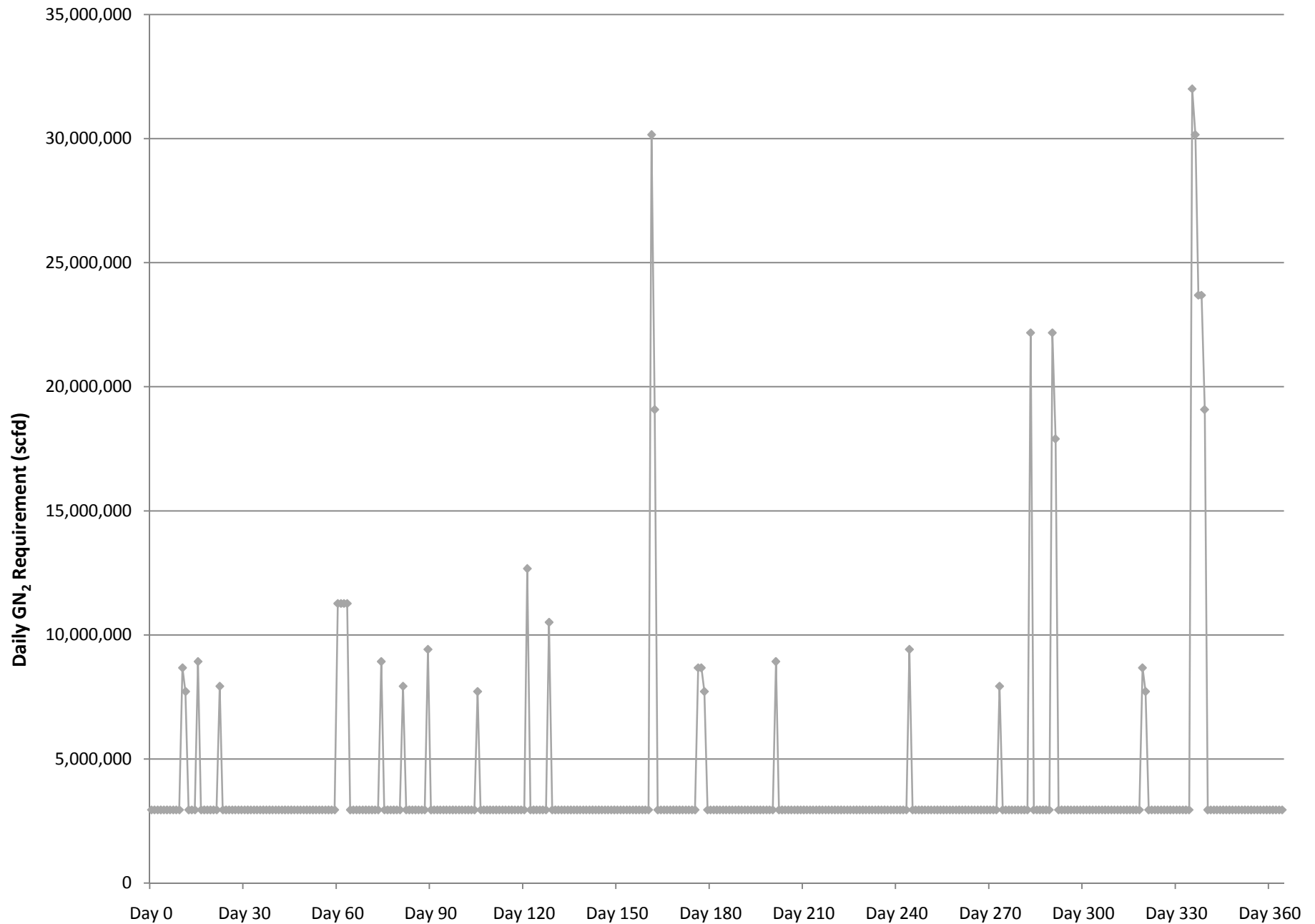
Appendix 3: Daily Liquid Oxygen Requirement on an Annual Basis



Appendix 4: Daily Liquid Hydrogen Requirement on an Annual Basis



Appendix 5: Daily Gaseous Nitrogen Requirement on an Annual Basis



Appendix 6: Daily Gaseous Helium Requirement on an Annual Basis

